Zootaxa 4221 (4): 477–485
http://www.mapress.com/j/zt/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

https://doi.org/10.11646/zootaxa.4221.4.4
http://zoobank.org/urn:lsid:zoobank.org:pub:7C02DD7F-71A2-4218-8662-CE01218582DB

A new species and the shallowest record of *Flabegraviera* Salazar-Vallejo, 2012 (Annelida: Flabelligeridae) from Antarctica

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Abstract

A new species of polychaete, *Flabegraviera fujiae* **sp. nov.**, is described and the first report of *F. mundata* (Gravier, 1906) from the shallow water around Syowa Station, Antarctica, is presented. *Flabegraviera fujiae* **sp. nov.** resembles *F. profunda* Salazar-Vallejo, 2012 but is discriminated from the latter by having eyes and an exposed cephalic cage. The specimen of *F. mundata* was collected from a depth of 8 m, providing the shallowest record of this species to date.

Key words: Polychaeta, taxonomy, Antarctica, Syowa Station, Nishinoura

Introduction

Flabegraviera Salazar-Vallejo, 2012 is a sedentary polychaete genus, members of which have only been found on the seabed around Antarctica. Among about 25 genera in the family Flabelligeridae (Jumars *et al*. 2015), it particularly resembles *Annenkova* Salazar-Vallejo, 2012, *Flabehlersia* Salazar-Vallejo, 2012, *Flabelliderma* Hartman, 1969, *Flabelligera* Sars, 1829, and *Flabesymbios* Salazar-Vallejo, 2012, because they share: 1) the cephalic cage, which is a complete cylinder surrounding the head, and 2) the multi-articulated neurohooks, each having a distally bent tip called the crest (Salazar-Vallejo 2007). *Flabegraviera* is distinguished from the aforementioned five *Flabelligera*-like genera by having a very thick, gel-like tunic and conspicuous, long notochaetae. It currently consists of two species, *Flabegraviera mundata* (Gravier, 1906) and *Flabegraviera profunda* Salazar-Vallejo, 2012. *Flabegraviera mundata* was originally described as *Flabelligera mundata* by Gravier (1906), but later transferred to *Flabegraviera* by Salazar-Vallejo (2012).

In recent years, understanding marine diversity and ecosystems around Antarctica in relation to human-induced impacts, including climate change, has become increasingly necessary (Constable *et al.* 2014; Chown *et al*. 2015). Therefore, we should increase our taxonomic knowledge of marine organisms in the southern polar region to facilitate speedy and accurate species identification (Kaiser *et al*. 2013). Although the macrobenthic fauna around Antarctica has been well documented through a long history of research, our knowledge on the benthic fauna in some parts of East Antarctica is still extremely limited because this area is largely inaccessible (Clarke *et al*. 2004; Griffiths *et al.* 2014).

The faunal diversity around Syowa Station, a Japanese research station located in East Antarctica, has been studied in the terrestrial environment including soil, vegetation, and lakes and in the marine environment including sea ice, shallow-water, and deep sea (Ohyama 1979; Numanami & Kosaka 1984; Hamada *et al.* 1986; Hoshiai & Tanimura 1986; Okutani 1986; Sugawara *et al.* 1995; Tsujimoto *et al*. 2014). There were a few intensive, shallow-water, macrobenthic faunal surveys conducted around Syowa Station in the 1980s (Watanabe *et al.* 1982; Numanami & Kosaka 1984; Hamada *et al.* 1986). However, in these studies, many of the animals were only briefly reported, leaving our knowledge on the biodiversity of macrobenthic fauna around this area largely limited; polychaetes in particular were left completely unidentified even to the family level.

Accepted by P. Hutchings: 17 Nov. 2016; published: 19 Jan. 2017

During dive sampling in 1981 at Nishinoura near Syowa Station KW collected two flabelligerid worms. We identified these two specimens as an undescribed species and *F. mundata*, respectively. The latter specimen provides the shallowest record of *F. mundata* to date.

Material and methods

Two worms were collected by SCUBA diving from 8–9 m depth in Nishinoura (69°00.4′ S, 39°34.5′ E) near Syowa Station, Lützow-Holm Bay, Antarctica, in 1981 during the 22nd Japanese Antarctic Research Expedition (JARE 22) summer operation by Yasushi Nakajima and Kentaro Watanabe. Detailed information about sampling method is provided by Nakajima *et al*. (1982) and Watanabe *et al*. (1982). Worms were fixed and preserved in 70% ethanol immediately after the collection at Syowa Station, then later stored at the National Institute of Polar Research (NIPR) in Tokyo, Japan. The preserved specimens were observed by a stereoscopic microscope (Nikon SMZ1500 and OLYMPUS BX51); photographs were taken by a digital camera (Nikon D5200 and OLYMPUS OMD-EM5). All the specimens have been transferred to the National Museum of Nature and Science, Tsukuba (NSMT), Japan.

Results

Systematics

Family Flabelligeridae de Saint-Joseph, 1894

Genus *Flabegraviera* Salazar-Vallejo, 2012

(New Japanese name: Kibukure-habouki-zoku)

Flabegraviera fujiae sp. nov.

(New Japanese name: Fuji-kibukure-habouki)
(Figs 1–2)

Type material. Holotype. NSMT-Pol-H-609. Complete (some chaetae broken, dissected), sex undetermined, non-reproductive-adult, Nishinoura (69°00.4′ S, 39°34.5′ E), 9 m depth, sandy mud, 16 Jan., 1981.

Description. Holotype (NSMT-Pol-H-609) 9.4 cm long, 1.8 cm wide. Body fusiform, covered by very thick tunic (Fig. 1A). Tunic transparent, gel-like, covering whole body except cephalic cage (partially eroded); sediment grains attached dorsally, ventrally, and laterally (size in long axis ~40 μm), not immersed in tunic. Body papillated; papillae long, clavate, forming sheath covering chaetae, mostly eroded. Lobe on dorsum of chaetiger 1 absent. Dorsal and ventral surface irregular.

Prostomium low cone. Branchiae 6–8 rows, about 110 filaments per side, 3–5 mm long, decreasing in size ventrally, black in ethanol. Branchial plate crescent-like, bisected by well-developed caruncle (Fig. 1B). Palps long (6 mm), cylindrical, pink in ethanol. Four black eyes present. Lateral and dorsal lips well developed; ventral lip reduced. Nephridial lobes present.

Chaetigers 33 in number; chaetiger 1 comprising cephalic cage. Cephalic cage 1.6 cm long, exposed whole, about 1/5 body length (9/10 body width), comprising 39 notochaetae and 24 neurochaetae per side. Chaetal transition from cephalic cage to body abrupt.

Parapodia well developed, completely covered by tunic, notopodia and neuropodia widely separated. Gonopodial lobe absent.

Chaetal bundles arranged into a straight series not like *F. mundata*. Notochaetae of two types: 1) multiarticulated, 1.2–3.4 cm long, 5–7 per fascicle (Fig. 2A); and 2) not multiarticulated, 3 mm long, 8–10 per fascicle (Fig. 2B). Neurochaetae multiarticulated capillaries in chaetiger 1. Neurohooks in chaetigers 2–33 (Fig. 2C, D), 3–5 per fascicle, anchylosed, 0.7–0.9 cm long, pale orange, covered by a cylindrical shaft; crest bending region anchylosed. Multiarticulated neurohooks absent.

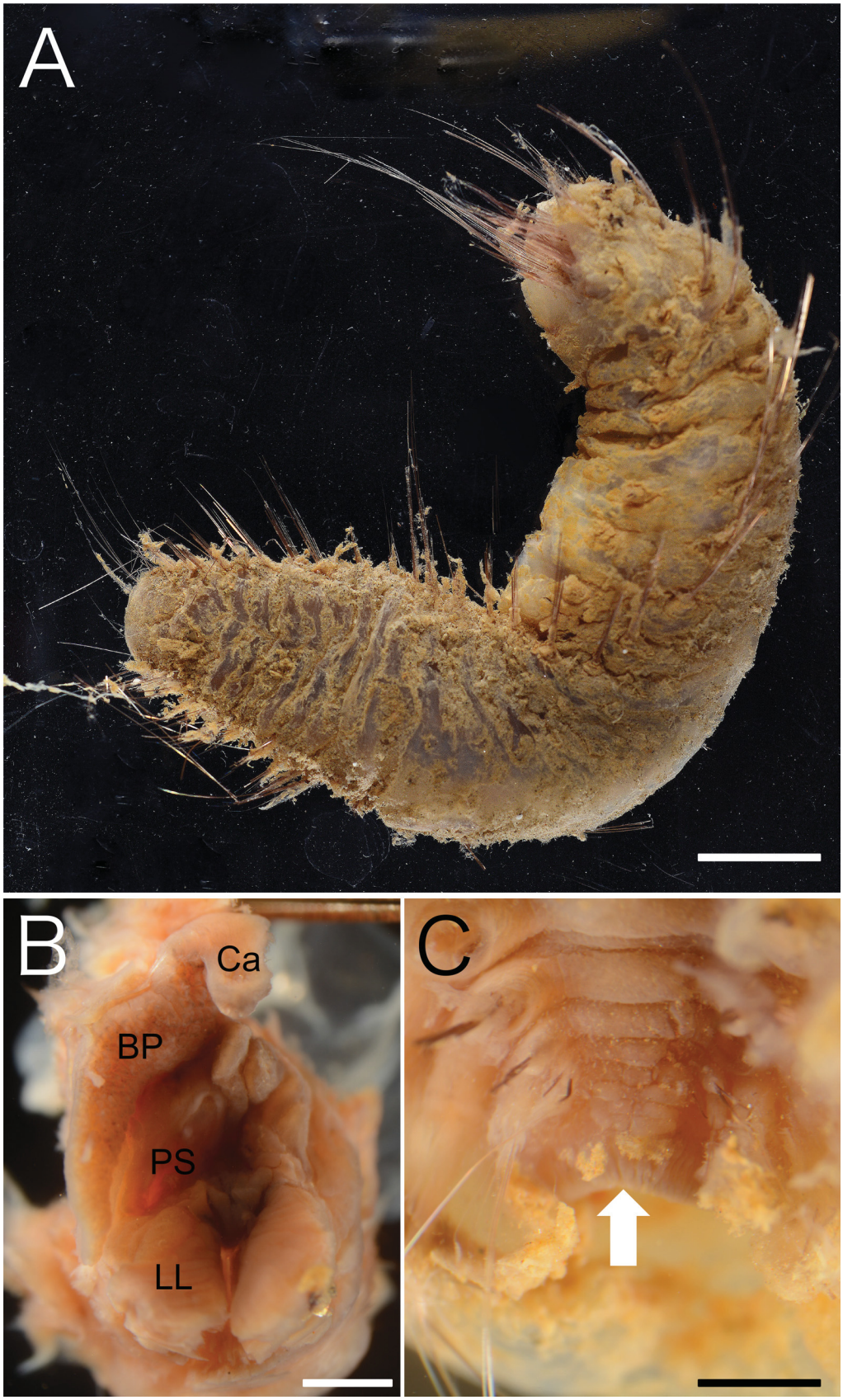

FIGURE 1. *Flabegraviera fujiae* **sp. nov.**, holotype, NSMT-Pol-H-609. A, Entire body, body twisted, anterior region in lateral view, posterior region in ventral view; head upper side; B, Head, frontal view; left half of branchial plate has been partly removed; branchiae and palps have been removed (BP, branchial plate; Ca, caruncle; LL, lateral lip; PS, palp scar); C, Posterior end, ventral view; arrow indicates ventral anal margin. Scale bars = 10 mm (A); 1 mm (B, C).

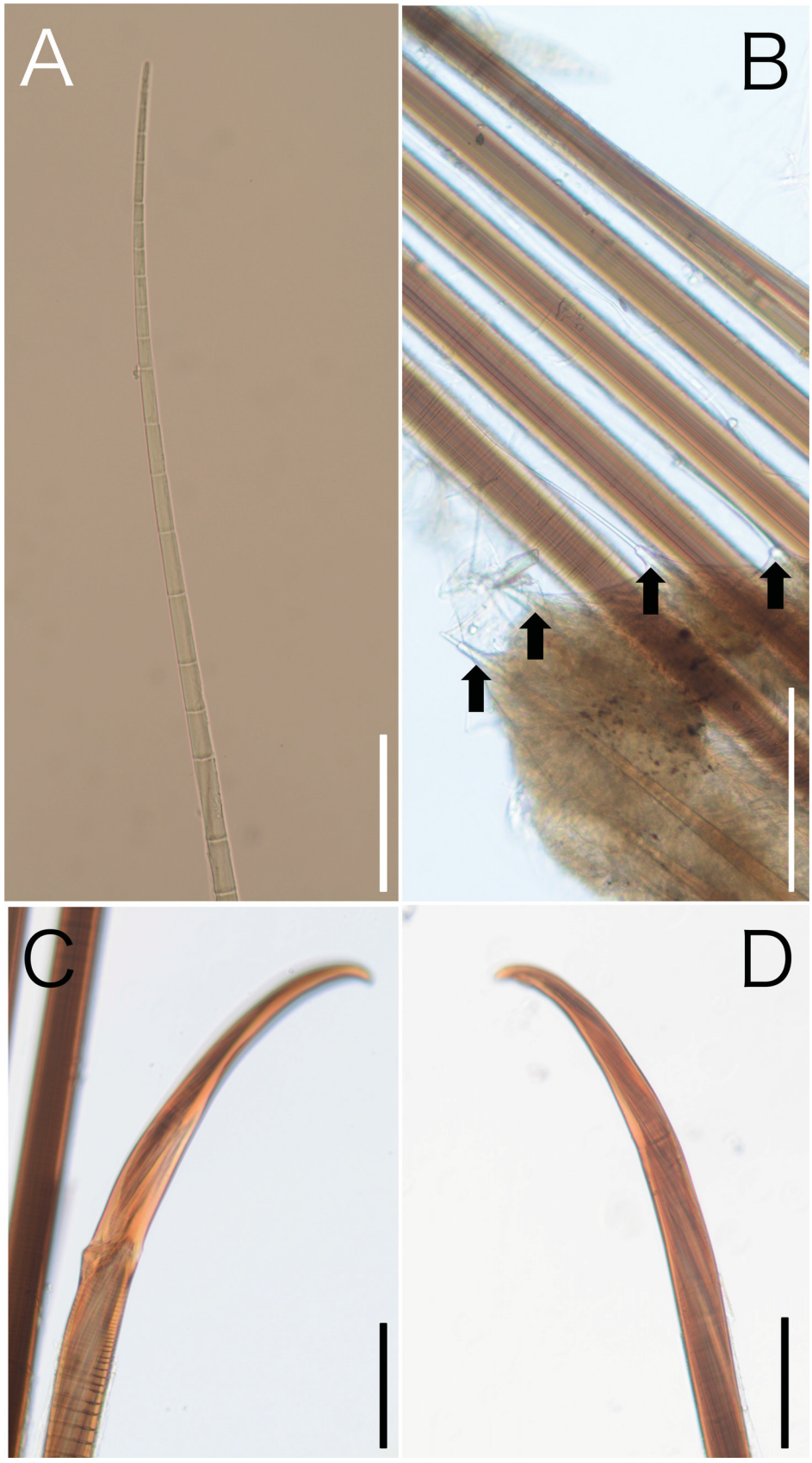

FIGURE 2. Micrographs of chaetae in *Flabegraviera fujiae* **sp. nov.**, holotype, NSMT-Pol-H-609. A, Chaetiger 29, tip of notochaeta; B, Same, base of notochaeta; black arrows indicate type 2 notochaetae; C, Chaetiger 6, tip of smaller neurohook; D, Chaetiger 27, tip of neurohook. Scale bars = 50 μm (A); 200 μm (B); 100 μm (C, D).

Posterior end exposed, truncate; last two segments achaetous; pygidium simple; no anal cirri; anus without pigment (Fig. 1C).

Etymology. The species is named after the Japanese icebreaker *Fuji*, utilized for the research operation during which KW collected the holotype. The derivation is made after the vessel's name taken as a feminine proper name. The new specific name is thus a noun in the genitive case. The Japanese name literally means 'Fuji's thickly dressed flabelligerid', derived from *kibukure* (thick-dressed) and *haboukigokai* (flabelligerid polychaete).

Remarks. Morphologically, *Flabegraviera fujiae* **sp. nov.** resembles *Flabegraviera profunda* Salazar-Vallejo, 2012 because in both species the notochaetal arrangement follows a straight-line, the neurohooks are anchylosed, and the tunic carries sediment grains. However, *F. fujiae* can be discriminated from *F. profunda* by the relative size and exposure of the cephalic cage, which is exposed almost entirely in *F. fujiae*, whereas it is covered by the tunic in *F. profunda*. In addition, the cephalic cage is about 1/5 body length in *F. fujiae*, compared to about 1/10 in *F. profunda*. An additional difference is that *F. fujiae* has eyes. Our specimen was collected from a depth of 9 m, that is markedly shallower than the previous records for *F. profunda*, collected in sediments at 330–450 m water depth (Salazar-Vallejo 2012).

Flabegraviera mundata (Gravier, 1906)

Flabelligera mundata Gravier, 1906, 537–538; Gravier 1907, 37–39, Pl. 4, Figs 31–32, Text figs 22–23; Gravier 1911, 110–112, Pl. 8, Fig. 87; Benham 1921, 108–109; Monro 1939, 130; Hartman 1952, 233; Hartman 1953, 50; Hartman 1966, 37–39, Pl. 11, Figs 1–4; Hartman 1967, 124; Hartman 1978, 170; Rozbaczylo 1985, 159; Hartmann-Schröder & Rosenfeldt 1989, 72; Knox & Cameron 1998, 72, Figs 137–139.
Flabegraviera mundata: Salazar-Vallejo 2012, 43–44, Fig. 18.
(New Japanese name: Kibukure-habouki)
(Figs 3–4)

Material examined. Nontype specimen. NSMT-Pol-113161. Complete (some chaetae broken, dissected), sex undetermined, non-reproductive adult, Nishinoura (69°00.4′ S, 39°34.5′ E), 8 m depth, sandy mud, 16 Jan., 1981.

Description. Nontype (NSMT-Pol-113161) 6.0 cm long, 1.1 cm wide, fusiform, covered by very thick tunic (Fig. 3A). Tunic transparent, gel-like, covering whole body and posterior portion of cephalic cage; sediment grains not attached. Body papillated; papillae long, clavate, forming sheath around base of chaetae. Lobe on dorsum of chaetiger 1 absent. Dorsal and ventral surface irregular.

Prostomium low cone. Branchiae 5–7 rows, about 120 filaments per side, 3 mm long, decreasing in size ventrally, colorless in ethanol. Branchial plate crescent-like, bisected by well-developed caruncle. Palps long (8 mm), cylindrical, grooved, pink in ethanol. Four black eyes present. Lateral and dorsal lips well developed, ventral lip reduced. Nephridial lobes present.

Chaetigers 30 in number; chaetiger 1 comprising cephalic cage. Cephalic cage 0.7 cm long, exposed for anterior 0.2–0.3 cm (Fig. 3B), about 1/10 body length (6/10 body width), comprising 36 notochaetae and 30 neurochaetae per side. Chaetal transition from cephalic cage to body abrupt.

Parapodia poorly developed, completely covered by tunic; notopodia and neuropodia widely separated. Gonopodial lobe absent.

Chaetal arrangement from chaetiger 1 (using "u" for upper, "m" for middle, and "l" for lower (cf. Salazar-Vallejo 2012)): ululumluml.... Notochaetae of single type, multiarticulated, 1.1–2.6 cm long, sickle-like, 4–6 per fascicle. Neurohooks in chaetigers 2–30 (Fig. 4A), 3 per fascicle, multiarticulated, 0.6–1.1 cm long, dark orange, covered by cylindrical shaft; handle anchylosed basally and distally, articulated in between, with 17 articles, progressively longer towards distal end (Fig. 4B); crest distinct, width : length = 1 : 7.

Posterior end not exposed; pygidium simple; no anal cirri; anus without pigment.

Remarks. The syntype specimens of *Flabegraviera mundata* (Gravier, 1906) were collected from 40 m and other specimens from a 20–385 m depth range (Salazar-Vallejo 2012). Our specimen was collected from 8 m depth, making it the shallowest record of the species. The finding of this species and also *F. fujiae* **sp. nov.** in shallow water means good opportunities for future research on adaptation of annelids to extreme environments, since the locality can be sampled using SCUBA.

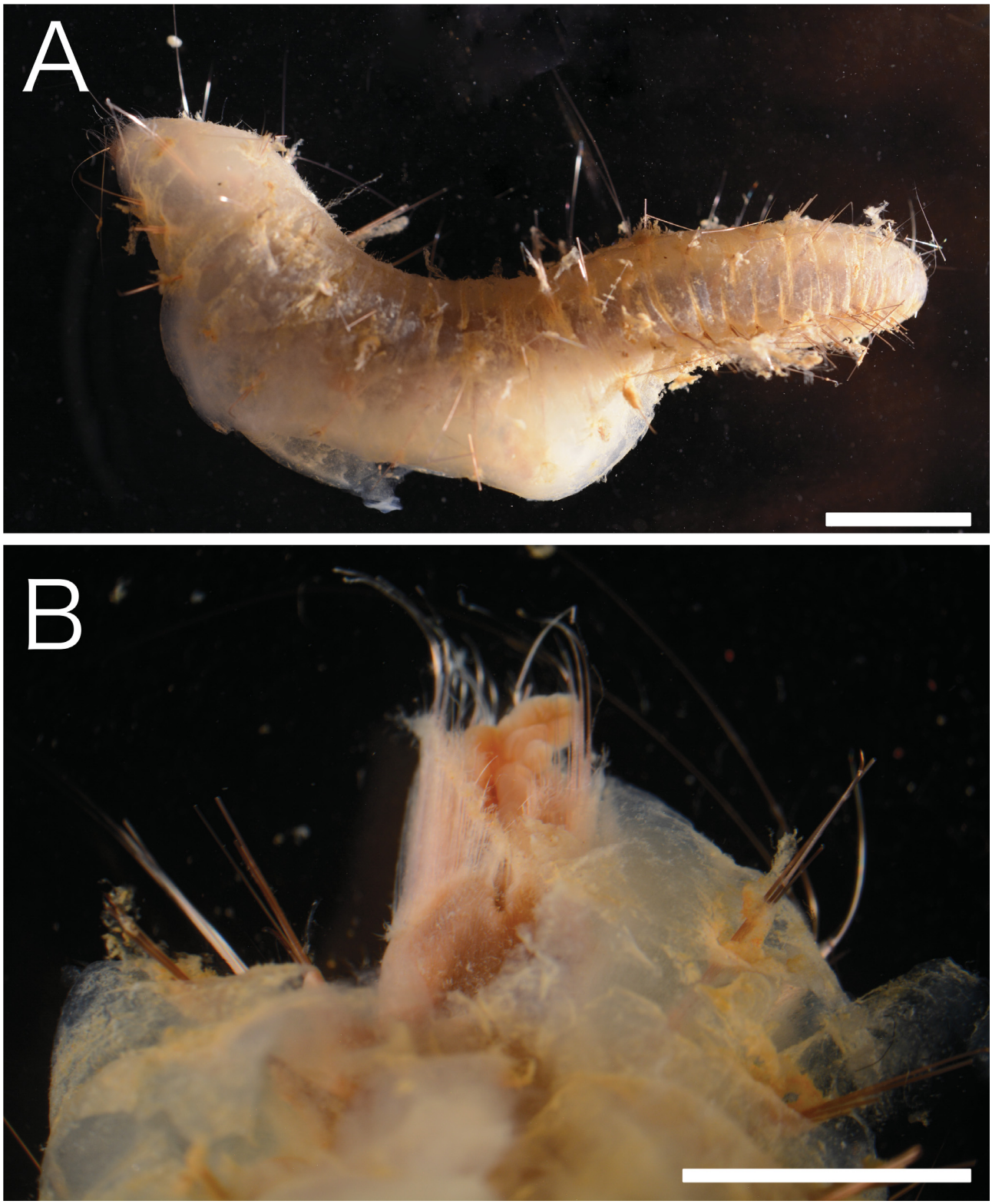

FIGURE 3. *Flabegraviera mundata* (Gravier, 1906), NSMT-Pol-113161. A, Entire body, lateral view; B, Same, anterior end, ventral view; tunic has been removed on left side. Scale bars = 10 mm (A); 5 mm (B).

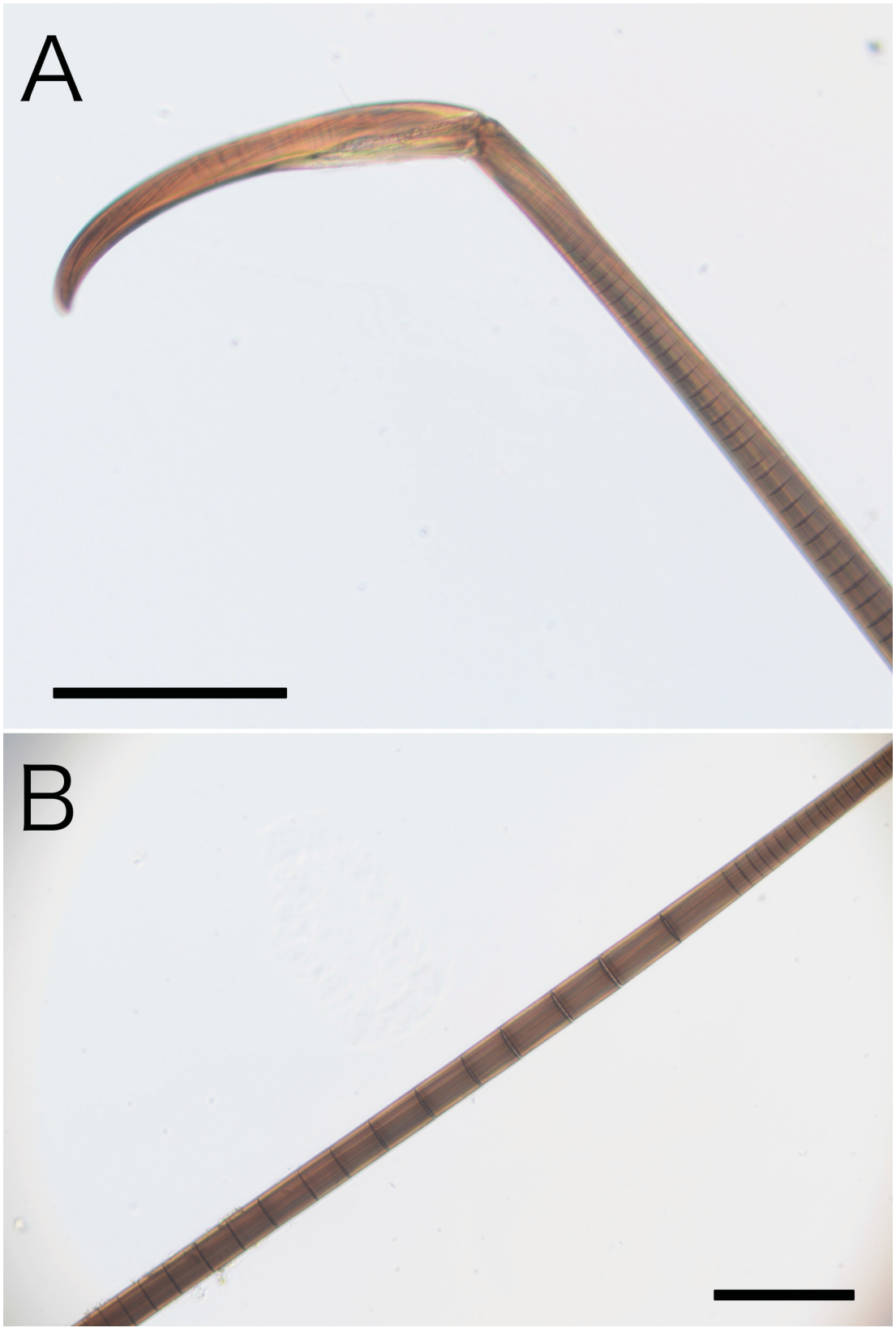

FIGURE 4. Micrographs of chaetae in *Flabegraviera mundata* (Gravier, 1906), NSMT-Pol-113161. A, Chaetiger 27, distal region of neurohook; B, Same, middle area of neurohook, right top is distal side. Scale bars = 200 μm.

Acknowledgments

We thank the expedition members of JARE 21 and 22 for the assistance in the SCUBA diving operation for sample collections. Yasuhiko Naito and Yasushi Nakajima conducted the diving operation with Kentaro Watanabe. Hiromi Uenishi provided the information on the two specimens originally stored at the NIPR herbarium. This study is an outcome of a NIPR workshop held in December 2015. This paper is a contribution of the SCAR AntEco Research Programme.

References

Benham, W. (1921) Polychaeta. Australasian Antarctic Expedition 1911–14 under the leadership of Sir Douglas Mawson. *Scientific Reports of the Australasian Antarctic Expedition 1911–1914, Series C, Zoology and Botany*, 3, 185–201.

Chown, S.L., Clarke, A., Fraser, C.I., Cary, S.C., Moon, K.L. & McGeoch, M.A. (2015) The changing form of Antarctic biodiversity. *Nature*, 522 (7557), 431–438. https://doi.org/10.1038/nature14505

Clarke, A., Aronson, R.B., Crame, J.A., Gili, J.M. & Blake, D.B. (2004) Evolution and diversity of the benthic fauna of the Southern Ocean continental shelf. *Antarctic Science*, 16 (4), 559–568. https://doi.org/10.1017/S0954102004002329

Constable, A.J., Melbourne-Thomas, J., Corney, S.P., Arrigo, K.R., Barbraud, C., Barnes, D.K., Gutt, J., Hindel, M.A., Hofmann, E.E., Hosie, G.W., Iida, T., Jacob, S., Jhonston, N.M., Kawaguchi, S., Kokubun, N., Koubbi, P., Lea, M., Makhado, A., Massom, R.A., Meiners, K., Meredith, M.P., Murphy, E., Nicol, S., Reid, K., Richerson, K., Riddle, M., Rintoul, S.R., Smith, W.O. Jr, Southwell, C., Stark, J.S., Sumner, M., Swadling, K.M., Takahashi, K.T., Trathan, P.N., Welsford, D.C., Weimerskirch, H., Westwood, K.J., Wienecke, B.C., Wolf-Gladrow, D., Wright, S.W., Xavier, J.C. & Ziegler, P. (2014) Climate change and Southern Ocean ecosystems I: how changes in physical habitats directly affect marine biota. *Global Change Biology*, 20 (10), 3004–3025. https://doi.org/10.1111/gcb.12623

de Saint-Joseph, A. (1894) Les annélides polychètes des côtes de Dinard, troisième partie (Nephtydiens–Serpuliens). *Annales des Sciences Naturelles, Zoologie, 7ème Série*, 17, 1–395.

Gravier, C. (1906) Sur les annélides polychètes recueillies par l'Expédition Antarctique Française (Aphroditiens, Amphinomiens, Flabelligériens, Maldaniens, Ampharétiens). *Bulletin du Museum d'Histoire Naturelle, Paris*, 12, 535–540.

Gravier, C. (1907) Annélides polychètes. *In*: Joubin, L. (Ed.), *Expédition Antarctique Française (1903–1905) Commandée par le Dr. Jean Charcot*. Masson et Cie, Paris, pp. 1–75.

Gravier, C. (1911) Annélides polychètes. *In*: Joubin, L. (Ed.), *Deuxième Expédition Antarctique Française (1908–1910) Commandée par le Dr. Jean Charcot*. Masson et Cie, Paris, pp. 1–165.

Griffiths, H.J., Van de Putte, A.P. & Danis, B. (2014) Chapter 2.2 Data distribution: Patterns and implications. *In*: De Broyer, C., Koubbi, P., Griffiths, H.J., Raymond, B., Udekem d'Acoz, C. d', de Putte, A.V., Danis, B., David,B., Grant, S., Gutt, J., Held, C., Hosie, G., Huettmann, F., Post, A. & Coudert, Y.R. (Eds.), *Biogeographic Atlas of the Southern Ocean*. Scientific Committee on Antarctic Research, Cambridge. pp. 16–26.

Hamada, E., Numanami, H., Naito, Y. & Taniguchi, A. (1986) Observation of the marine benthic organisms at Syowa Station in Antarctica using a remotely operated vehicle. *Memoirs of National Institute of Polar Research, Special Issue*, 40, 289–298.

Hartman, O. (1952) The marine annelids of the United States Navy Antartic Expedition, 1947–48. *Journal of the Washington Academy of Sciences*, 42, 231–237.

Hartman, O. (1953) Non-pelagic Polychaeta of the Swedish Antarctic Expedition 1901–1903. *Further Zoological Result on the Swedish Antarctic Expedition 1901–1903, under the Direction of Dr. Otto Nordenskjöld*, 4 (11), 1–83.

Hartman, O. (1966) Polychaeta Myzostomidae and Sedentaria of Antartica. *Antartic Research Series*, 7, 1–155. https://doi.org/10.1029/AR007

Hartman, O. (1967) Polychaetous annelids collected by the USNS Eltanin and Staten Island cruises, chiefly from Antarctic Seas. *Allan Hancock Monographs in Marine Biology*, 2, 1–387.

Hartman, O. (1969) *Atlas of the Sedentariate Polychaetous Annelids from California*. Allan Hancock Foundation, University of Southern California, Los Angeles.

Hartman, O. (1978) Polychaeta from the Weddell Sea Quadrant, Antarctica. *Antarctic Research Series*, 26, 125–222. https://doi.org/10.1029/AR026p0125

Hartmann-Schröder, G. & Rosenfeldt, P. (1989) Die Polychaeten der "Polarstern"-Reise ANT III/2 in die Antarktis 1984. Teil 2: Cirratulidae bis Serpulidae. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut*, 86, 65–106.

Hoshiai, T. & Tanimura, A. (1986) Sea ice meiofauna at Syowa Station, Antarctica. *Memoirs of National Institute of Polar Research, Special Issue*, 44, 118–124.

Jumars, P.A., Dorgan, K.M. & Lindsay, S.M. (2015) Diet of worms emended: an update of polychaete feeding guilds. *Annual*

Review of Marine Science, 7, 497–520.
https://doi.org/10.1146/annurev-marine-010814-020007

Kaiser, S., Brandão, S.N., Brix, S., Barnes, D.K., Bowden, D.A., Ingels, J., Leese, F., Schiaparelli, S., Arango, C.P., Badhe, R., Bax, N., Blazewicz-Paszkowycz, M., Brandt, A., Brenke, N., Catarino, A.I., David, B., Ridder, C.D., Dubois, P., Ellingsen, K.E., Glover, A.G., Griffiths, H.J. Gutt, J., Halanych, K.M., Havermans, C., Held, C., Janussen, D., Lorz, A.-N., Pearce, D.A., Pierrat, B., Riehl, T., Rose, A., Sands, C.J., Soler-Membrives, A., Schuoller, M., Strugnell, J.M., Vanreusel, A., Veit-Kohler, G., Wilson, N.G. & Yasuhara, M. (2013) Patterns, processes and vulnerability of Southern Ocean benthos: a decadal leap in knowledge and understanding. *Marine Biology*, 160 (9), 2295–2317.
https://doi.org/10.1007/s00227-013-2232-6

Knox, G.A. & Cameron, D.B. (1998) The marine fauna of the Ross Sea: Polychaeta. *National Institute of Water and Atmospheric Research, Biodiversity Memoir*, 108, 1–125.

Monro, C.C.A. (1939) Polychaeta. *Reports of the British Antarctic Research Expedition 1929–1931, Series B*, 4 (4), 87–156.

Nakajima, Y., Watanabe, K. & Naito, Y. (1982) Diving observations of the marine benthos at Syowa Station, Antarctica. *Memoirs of National Institute of Polar Research, Special Issue*, 23, 44–54.

Numanami, H. & Kosaka, M. (1984) Distribution of carnivorous benthic invertebrate in the northeastern part of Lützow-Holm Bay, Antarctica. *Memoirs of National Institute of Polar Research, Special Issue*, 32, 105–111.

Ohyama, Y. (1979) Notes on the free-living mites in the ice-free areas around Syowa Station. *Memoirs of National Institute of Polar Research, Special Issue*, 11, 127–129.

Okutani, T. (1986) A note on Antarctic benthic mollusks collected with a beam-trawl from Breid Bay by the 25th Japanese Antarctic research expedition. *Memoirs of National Institute of Polar Research, Special Issue*, 40, 277–287.

Rozbaczylo, N. (1985) Los anélidos poliquetos de Chile: Indice sinonímico y distribución geográfica de especies. *Facultad de Ciencias Biológicas, Pontificia Universidad Católica de Chile, Monografías Biológicas*, 3, 1–284.

Salazar-Vallejo, S.I. (2007) Revision of *Flabelliderma* Hartman, 1969 (Polychaeta: Flabelligeridae). *Journal of Natural History*, 41, (33–36), 2037–2061.
https://doi.org/10.1080/00222930701536443

Salazar-Vallejo, S.I. (2012) Revision of *Flabelligera* Sars, 1829 (Polychaeta: Flabelligeridae). *Zootaxa*, 3203, 1–64.

Sars, M. (1829) *Bidrag til Söedyrenes Naturhistorie; Förste Hæfte*. Dahl, Bergen, 60 pp.

Sugawara, H., Ohyama, Y. & Higashi, S. (1995) Distribution and temperature tolerance of the Antarctic free-living mite *Antarcticola meyeri* (Acari, Cryptostigmata). *Polar Biology*, 15 (1), 1–8.
https://doi.org/10.1007/bf00236117

Tsujimoto, M., McInnes, S.J., Convey, P. & Imura, S. (2014) Preliminary description of tardigrade species diversity and distribution pattern around coastal Syowa Station and inland Sør Rondane Mountains, Dronning Maud Land, East Antarctica. *Polar Biology*, 37 (9), 1361–1367.
https://doi.org/10.1007/s00300-014-1516-8

Watanabe, K., Nakajima, Y. & Naito, Y. (1982) SCUBA ice diving along the coast of East Ongul Island, Antarctica. *Antarcitc Record*, 75, 75–92. [in Japanese with English abstract]